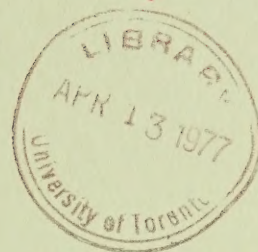
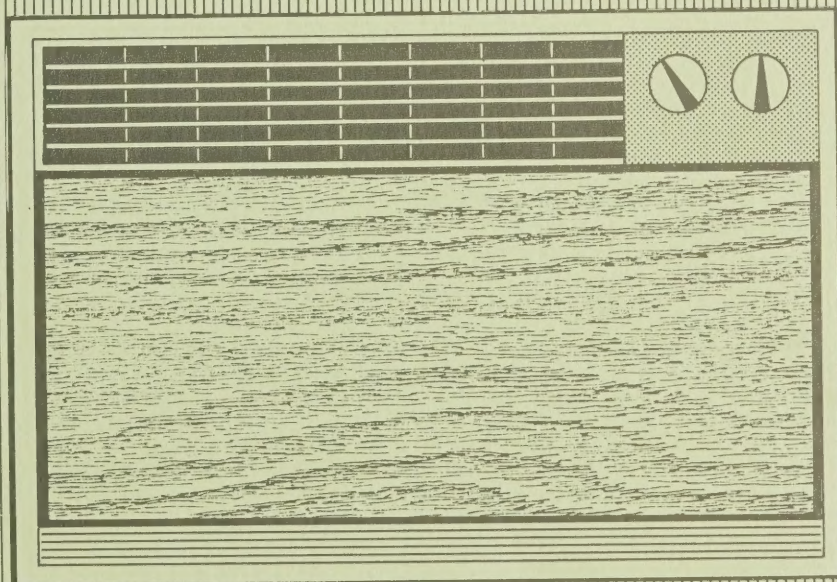


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C.A.M.A. ROOM AIR CONDITIONER



Ministry of
Colleges and
Universities

Program
Resources
Branch

C.A.M.A.ROOM AIR CONDITIONERMAJOR APPLIANCESERVICE TECHNICIANFOREWORD

This Training Specification is issued by the Program Resources Branch, Ontario Ministry of Colleges and Universities.

The Training Consultant group, under Mr. G.I. Bruce, initiated a study by selecting representatives from industry to assist in the preparation of a curriculum. This sub-committee was Chaired by Mr. E.G. Davis, and was composed of the following representatives from industry:

Mr. N. Edge	Westinghouse Ltd., Toronto
Mr. H. Hardy	G.S.W. Home Service, Toronto
Mr. A. Kleefer	Electrohome Ltd., Kitchener
Mr. P. Mavety	Canadian General Electric, Toronto
Mr. L. Zarins	Sears, Toronto

Examinations, for the purpose of supporting this program, were developed by Mr. H. Kotiesen and Mr. A. Brierley, Examinations Development Coordinators of the Program Resources Branch.

The writing of examinations is arranged, by demand, through the Industrial Training Branch.

ROOM AIR CONDITIONER

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SPECIFIC PERFORMANCE OBJECTIVES AND CRITERIA FOR : ROOM AIR CONDITIONER

CCDO No.

TERMINAL PERFORMANCE OBJECTIVES

: To be able to...

- LOCATE:
- AIR CONDITIONING UNIT
 - of the following types:
 - window units
 - wall units

ENABLING OBJECTIVES


: Will be able to...

- Read prints and schematics
- Determine and select a suitable location based upon the:
 - environmental conditions
 - design and layout of a residence or a room
 - performance characteristics of the equipment
 - accessibility to repair and operate the system
 - cost of installation
 - requirements for safe location of the system
- Identify possible annoyances such as:
 - hot air discharge from the condenser
 - noise
 - disposal of condensate

TERMINAL PERFORMANCE CRITERIA

: Minimum acceptable standard...

- Residential air conditioners should be located in a clean and dry area. They must be protected from sources of damage. The location of the air conditioner will ensure:
- adequate cooling of the condenser
 - adequate air circulation through the evaporator
 - a solid mounting facility
 - ease for installation and service
 - conformance to manufacturer's code for installation
 - safety for people



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ESTIMATE - HEAT LOAD CONDITION	<ul style="list-style-type: none">- Read prints, schematics, drawings, charts and tables- Complete, alternatively, the Manufacturer's Estimate Form for the purpose of calculating HEAT GAIN or HEAT LOAD	<p>Determine total heat load utilizing the Manufacturer's Estimate Form.</p> <p>Such load will usually be expressed as B.T.U.s required for a specific application.</p>	

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INSTALL - AIR CONDITIONERS - window units - wall units	<ul style="list-style-type: none"> - Read and understand pictorial diagrams, drawings, schematics, sketches, and symbols - Select and operate the required tools in order to ensure that: <ul style="list-style-type: none"> - the window unit is installed safely - the unit is securely fastened in position - the unit is sealed to minimize air infiltration - the window is secured in the proper position - Select and operate the required measuring instruments to check: <ul style="list-style-type: none"> - alignment and proper mounting of the equipment - the housing adjustment to ensure approx. $\frac{1}{4}$ inch tilt downward on the outside of the window in order to provide for condensate drainage if condensation should occur on the exhaust side of these units - Determine and apply the correct methods to: <ul style="list-style-type: none"> - facilitate a leakproof seal, and securely install window and wall units in accordance with the manufacturer's design and recommendations 	<p>Window units will be installed with a slight downward tilt toward the outdoors. A security bracket must be employed to mount the window unit firmly in position.</p> <p>Electrical connections will comply with the manufacturer's specifications and installation codes. Window and wall units must employ polarized (three prong) plugs.</p> <p>The circuit should be protected by a circuit breaker or a time delay fuse. The wall outlet should be checked to ensure that it is grounded to accommodate the air-conditioner's three pronged plug.</p>	

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INSTALL: - CONTROL DEVICES - ELECTRICAL - thermostats - contactor relays - indoor fan relay - overload switches - fuses - capacitors	<ul style="list-style-type: none"> - Read and understand manufacturer's diagrams and schematics for air conditioning units - Select and apply the required tools and techniques in order to ensure: <ul style="list-style-type: none"> - accurate mounting of components - clean and firm electrical connections - adjustment of controls according to the manufacturer's specifications - Select and operate the required measuring instruments to check: <ul style="list-style-type: none"> - electrical parts in a circuit - a single phase circuit - Determine and apply the correct methods to ensure: <ul style="list-style-type: none"> - that the various control devices are functional and suitable in the unit for which they are employed - that optimum performance is enjoyed by the customer - that procedures for safety are employed in the area of work 	Control devices will be installed and adjusted according to the manufacturer's specifications. Instruments will be employed to check circuits to determine if they are electrically charged before handling wires, terminals, or parts. The electrical power will be disconnected before working on the electrical parts of an air conditioning unit.	

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READ: - prints - schematics - diagrams - symbols	<ul style="list-style-type: none"> - Identify and interpret: <ul style="list-style-type: none"> - the name plate - isometric, and multi-view projections - dimensions, fits, tolerances, and abbreviations - electrical symbols - job specifications and addendums - Interpret numerical values and their associated units based upon: <ul style="list-style-type: none"> - the British system - the Metric system - Read manufacturer's instructions and specifications - Identify and interpret data for the selection of: <ul style="list-style-type: none"> - tools - hardware - wiring - replacement parts 	Read prints, schematics, and diagrams - to determine the mounting area and mounting methods - to enable the installation of: - window and wall units - to determine wiring layout - to enable the calculation of air conditioning loads - to enable troubleshooting and repair of the unit	

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<ul style="list-style-type: none"> - MAINTAIN - AIR CONDITIONERS of the following types: <ul style="list-style-type: none"> - window units - wall units 	<ul style="list-style-type: none"> - Read prints, schematics, charts, and tables - Identify all the components of the unit, and determine the fundamentals of operation of each component - Apply methods of troubleshooting when a malfunction is present in a window or wall unit - Formulate and apply methods of overhauling units for maintenance purposes including: <ul style="list-style-type: none"> - checking and replacing filters - adjusting belts and pulleys - checking controls and control valves - checking, contacts, relays, and electrical controls - replacing oil and driers - testing for leaks in the system - draining, flushing, and cleaning water hoses and tubes - measuring gas, liquid pressure, and temperature - the lubrication of all of the areas necessary to ensure the smooth operation of the unit - Charge and evacuate units if necessary - Operate the tools and measuring instruments necessary for the maintenance of air conditioners 	<p>System malfunctions must be recognized. Maintenance tasks will be performed safely. The complete unit must be checked to ensure:</p> <ul style="list-style-type: none"> - clean tubing, hoses, and filters - proper assembly operation - no impurities in the refrigerant and the oil - proper operation of controls - sufficient lubrication of moving parts - clean cooling fins and condenser fins - clean coils behind grilles - safe electrical connections and controls - conformance with local electrical codes and, if necessary, circuitry protection by a circuit breaker or time-delay fuse. Wall (A.C.) outlets should be checked to ensure a ground to accommodate the air conditioners three-prong plug. 	

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<p>IDENTIFY:</p> <ul style="list-style-type: none"> - REFRIGERANT <p>of the following types:</p> <ul style="list-style-type: none"> - R-12 - R-22 	<ul style="list-style-type: none"> - Read tables, charts, and drawings - Select and operate the necessary test and measuring instruments - Read identification label on appliance or the stamping on the compressor - Determine thermodynamic properties of the following types: <ul style="list-style-type: none"> - pressure - temperature - Check pressures to chart for confirmation of refrigerant type - Apply safety measures: <ul style="list-style-type: none"> - by wearing protective eye covering - by ensuring sufficient ventilation - by using protective equipment if required - by following safety rules and good house-keeping policies 	<p>The refrigerant must be correctly identified as to type based upon:</p> <ul style="list-style-type: none"> - tables and charts - material properties - thermodynamic properties <p>or by reading the identification label if available, and affixed on the air conditioning unit.</p>	

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<p>TROUBLESHOOT SYSTEM MALFUNCTIONS</p> <ul style="list-style-type: none"> - Apply systematic diagnostic techniques to malfunctions in room air conditioners - Recognize satisfactory and below standard operation of air conditioning units related to: <ul style="list-style-type: none"> - air cooling and exhaust-air function - noise parameters - cycling of the unit - Troubleshoot malfunctions by applying knowledge about the design fundamentals of: <ul style="list-style-type: none"> - air cleaning and filtering units - refrigerant systems - air handling deflectors - Select and measure the required conditioning temperature and pressure check points - Understand the operation of typical control systems and the function of control devices, (manual and automatic) such as: <ul style="list-style-type: none"> - electric - refrigerant controls - motor controls - temperature controls - limit controls - overload and safety controls - fan relay controls - Select and operate leak detectors - Select and operate the required measuring and checking instruments 	<ul style="list-style-type: none"> - low capacity at compressor - excessive heat load - air and moisture in the system - undercharged systems - dirty condenser - overcharged systems - dirty air filter on evaporator - frozen up evaporator <p>Recommendations will be made for repair or replacement of a part or assembly. Trouble-shooting will be done safely and without damage to the unit.</p> <p>Manufacturer's recommendations about diagnostic, or troubleshooting procedures, techniques will be employed by the Service Technician.</p>		

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	<ul style="list-style-type: none">- Measure and check all system parameters- Estimate - heat load condition- Read prints and schematics		

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<ul style="list-style-type: none">- CONNECT AND OPERATE- THE GAUGE MANIFOLD <p>NOTE: The gauge manifold includes the following components:</p> <ul style="list-style-type: none">- hoses- couplings- valves- gauges and gauge openings	<ul style="list-style-type: none">- Read diagrams, charts and tables- Operate the correct tools and equipment for:<ul style="list-style-type: none">- mounting the manifold securely- connecting hoses, tubing and couplings- cleaning the gauges and the valves- repairing leaks- Select the correct size of hoses and couplings and determine the location in the system to connect the required component- Identify and determine the fundamentals of operation of each component- Detect, isolate and repair leakage in the component- Determine the correct methods to operate the gauge manifold according to the function to be performed, such as:<ul style="list-style-type: none">- reading pressures- charging (oil and refrigerant)- testing for leaks- Disconnect and remove the gauge manifold so that:<ul style="list-style-type: none">- no air is admitted to the system- no refrigerant or oil is lost in the system	<p>The gauge manifold will be connected safely and securely to prevent leakage in the connections.</p> <p>The gauge manifold will be operated safely to perform functions such as:</p> <ul style="list-style-type: none">- taking pressure readings- checking for leaks in the system- charging and evacuating- adding oil- by-passing the compressor- unloading the gauge lines of high pressure liquid and vapor <p>No leakage is permitted. Air must not be admitted, and no refrigerant or oil lost after the manifold is disconnected.</p> <p>The gauge manifold will be stored safely.</p>	

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<ul style="list-style-type: none">- SELECT AND OPERATE- POWER TOOLSof the following types:- Drills- Hammers- Saws- Soldering Guns	<ul style="list-style-type: none">- Read charts and tables- Identify the specified power tools based upon:<ul style="list-style-type: none">- types and sizes- application- operating range- Determine the methods of assembling and adjusting the power tools and their accessories- Identify the number and symbol classification.- Store and maintain tools safely- Determine the types and sizes of fasteners, or work materials, on which the tools will be applied for installation and service- Determine the methods of applying the power tools for:<ul style="list-style-type: none">- safe operation- restricted applications- most efficient employment of the tool- Determine the correct power connections based upon:<ul style="list-style-type: none">- voltage- current- male/female plugs and receptacles	<p>Power tools must be correctly selected for their:</p> <ul style="list-style-type: none">- type- size and shape- capacity <p>Power tools must also be selected for:</p> <ul style="list-style-type: none">- the type of operation to be performed- the type of material to be worked- the dimensional restriction in which to operate the tool- the force to be applied- the operating rate- the most efficient usage <p>All operations involving the use of power tools will be performed efficiently and safely, and comply with the applicable codes and regulations.</p>		

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<ul style="list-style-type: none"> - SELECT AND USE - HAND TOOLS - of the following types: - screwdrivers - wrenches - Allen keys - scrapers and chisels - metal and wood saws - files and reamers - pliers - pipe cutting, flaring, and bending tools - hammers - cutters and shears - drifts and punches - clamps and vises - braces and drill bits 	<ul style="list-style-type: none"> - Identify the types of hand tools specified in terms of their: <ul style="list-style-type: none"> - size and shape - applications to specific materials - capacity for strength - operating range - Determine the methods of assembling and adjusting the necessary hand tools - Read charts and tables - Identify the number and symbol classification - Store and maintain tools in good condition - Determine the type of fasteners, or work materials, on which the tools will be applied - Determine the methods of applying the hand tools for: <ul style="list-style-type: none"> - safe operation - restricted operations - the most efficient use to perform the following operations: <ul style="list-style-type: none"> - holding - fastening - cutting - material removal - Determine the optimum drill bit for producing the required bore working with: <ul style="list-style-type: none"> - wood - metal - masonry - plastic 	<p>Hand tools must be correctly selected for:</p> <ul style="list-style-type: none"> - type - size and shape - capacity <p>And for:</p> <ul style="list-style-type: none"> - the type of operation to be performed - the type of material to be used - the dimensional restrictions in which to perform the operation - the necessary force to be applied - the operating rate - the most efficient usage <p>All operations involving the application of hand tools will be performed efficiently and safely.</p>	

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<p>SELECT AND OPERATE</p> <p>- MEASURING AND TEST INSTRUMENTS of the following types:</p> <ul style="list-style-type: none">- Volt/OHM Metre (V.O.M.)- tapes and rules- spirit levels- hydrometers and moisture indicators (sling psychrometer)- test cord set- pH indicators <p>leak detection devices of the following types:</p> <ul style="list-style-type: none">- Halide leak detector- electronic leak detector- soap test	<ul style="list-style-type: none">- Read and understand the applications of Ohm's Law- Read and understand diagrams, schematics, and symbols- Identify the various types and applications of measuring instruments- Adjust and calibrate the test instrument- Select the correct range and scale- Select, connect and operate the required instrument based upon:<ul style="list-style-type: none">- the accessories required for proper operation- its respective application for:<ul style="list-style-type: none">- checking continuity- checking single phase circuits- checking and measuring voltage (AC-DC), amperage (AC-DC), resistance- checking capacitors- the instruments limitations for:<ul style="list-style-type: none">- measurement of range- scale value- sensitivity- resolution and precision- Interpret meter readings accurately as to value and unit of measurement- Handle, maintain, and store instruments with care	<p>Select and operate measuring and test instruments to facilitate installation and service to:</p> <ul style="list-style-type: none">- measure and align- the electrical circuits- the air conditioning system <p>Select and operate an instrument based upon:</p> <ul style="list-style-type: none">- a specific application- defined limitations <p>Check and measure AC-DC circuits and components.</p> <p>All operations must be performed safely.</p> <p>Readings must be accurate, and manufacturer's recommendations relative to the operation of a specific instrument must be followed by the operator.</p>		

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<ul style="list-style-type: none"> - SELECT AND USE - HARDWARE of the following types: - clips and pins - clamps or fasteners - support brackets - wall braces 	<ul style="list-style-type: none"> - Read charts and drawings - Identify the various types and applications of hardware to mount the unit - Select the correct piece of hardware based upon: <ul style="list-style-type: none"> - size - type - length - application for the following materials: <ul style="list-style-type: none"> - metals - wood - concrete - plastics of various thicknesses 	<p>Select the correct hardware for an application based upon:</p> <ul style="list-style-type: none"> - size - type - length <p>for various materials</p> <p>The correct hardware recommended by the manufacturer will be employed to mount and secure the window or wall unit.</p>	

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<ul style="list-style-type: none"> - TEST AND REPAIR OR REPLACE - SYSTEM CONTROLS of the following types: <ul style="list-style-type: none"> - thermostats - pressure switches - contactor relays - fuses - capacitors 	<ul style="list-style-type: none"> - Read and work with schematics and diagrams - Assemble and disassemble all the specified controls of the unit - Operate the controls by adjusting them manually - Identify the components of the controls and determine the fundamentals of operation of each component - Select and operate the correct tools for the repair operation - Select and operate the proper measuring instruments to isolate the malfunction - Employ a methodical troubleshooting service analysis in home or shop - Determine the tolerance range for the control setting - Select the correct replacement components - if necessary 	<p>The source of the malfunction must be isolated. The units controls will be repaired or replaced safely with minimal disruption to the machine. All repair operations on A/C units will:</p> <ul style="list-style-type: none"> - ensure proper electrical wiring and connections - maintain the proper: <ul style="list-style-type: none"> - temperature - humidity within the specified tolerance range. <p>The testing and repair of air conditioning units will be accomplished by following the manufacturer's recommended instructions and/or directions.</p> <p>The manufacturer's guidelines for safety must be followed during test and repair operations.</p>	

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<ul style="list-style-type: none"> - BRAZE AND SOLDER 	<ul style="list-style-type: none"> - Operate gas welding equipment of the following types: <ul style="list-style-type: none"> - oxyacetylene - propane - Read charts and tables - Select proper torches and tips for: <ul style="list-style-type: none"> - brazing - soldering for various types, shapes, and sizes of material - Apply techniques to braze and solder joints - Select proper filler metals and apply to the correct areas of the work pieces - Determine the correct adjustment for: <ul style="list-style-type: none"> - amount of heat - flame size - type of flame - Apply flux at correct speed and location - Utilize inert gases to prevent oxidation - Select and operate the necessary tools for: <ul style="list-style-type: none"> - securing the workpiece - preparing the workpiece - Position the flame for a clean, efficient, and secure joining of the workpiece - Apply techniques for flat and horizontal position brazing and soldering 	<p>The workpiece must have a clear appearance and be free of porosity or granular joints. Joints must be uniformly penetrated with a minimum amount of filler metal. The workpiece must surpass visual and/or nondestructive testing specifications. All operations will be accomplished safely.</p>

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<ul style="list-style-type: none"> - REPAIR AIR CONDITIONERS of the following TYPES: <ul style="list-style-type: none"> - window units - wall units 	<ul style="list-style-type: none"> - Read prints, schematics, graphs, charts and tables - Shut-down and start the system - Select and operate: <ul style="list-style-type: none"> - the required tools - the measuring instruments - Troubleshoot the unit by systematic analysis to locate the malfunction - Select the correct replacement components - Repair or replace the following system components: <ul style="list-style-type: none"> - the evaporator assembly - the condenser assembly - the compressor assembly - the metering device - the refrigerant lines - the electrical wiring - the electrical controls - Repair the system by: <ul style="list-style-type: none"> - replacing filters and driers - repairing leaks - evacuating the system - replacing faulty components - lubricating the fan bearings where necessary - eliminating noise - Charge the system - Test and adjust the system controls 	<p>The source of the malfunction must be isolated.</p> <p>All residential air conditioners will:</p> <ul style="list-style-type: none"> - have no refrigerant leaks - be mounted firmly and levelled according to manufacturer's specifications - maintain proper condenser ventilation - have proper mechanical and electrical connections - ensure correct air flow, balance, and distribution - maintain the desired temperature and humidity levels, if properly sized - operate with minimal noise and vibrations - be repaired safely according to codes to meet manufacturer's specifications 	

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	<ul style="list-style-type: none">- Apply safety measures:<ul style="list-style-type: none">- by wearing protective clothing- to use brazing equipment, hand and power tools- by following safety rules or codes		

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EVACUATE REFRIGERANT - Room Air Conditioners	<ul style="list-style-type: none"> - Determine if a unit has been over-charged - Remove refrigerant safely from a window or wall unit by: <ul style="list-style-type: none"> - venting to the atmosphere, (outdoors if possible), as a vapor - Apply the required methods during evacuation in order to: <ul style="list-style-type: none"> - prevent a freeze up when removing refrigerant - prevent the refrigerant boiling-off at its saturated temperature - avoid spraying oil over the area adjoining the escaping refrigerant - prevent the refrigerant from the window or wall unit from contaminating a dwelling 	All evacuations of refrigerant will be accomplished by an economical and safe method.	

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CHARGE: - ROOM AIR CONDITIONERS of the following types: - window units - wall units	<ul style="list-style-type: none"> - Determine and apply, for each unit, the correct method for liquid or vapor charging utilizing an efficient and safe procedure - Determine the correct charging apparatus and type of refrigerant in order to: <ul style="list-style-type: none"> - ensure that the Service Cylinder is filled to a safe level with the refrigerant required by the unit - determine the weight of the refrigerant required by the proper use of weigh scales - make a record of the weight charged into the unit - accomplish vapor charging by means of a gauge manifold into the compressor suction service-valve-port - install a piercing-valve, or fitting, in the suction line if vapor charging is to be implemented - Determine and charge the required amount of refrigerant by the following methods: <ul style="list-style-type: none"> - weighing the charge or dial-a-charge - checking liquid subcooling - charging by superheat - charging by manufacturer's charging charts 	<p>All specified operations must ensure that the air conditioning unit is not under-charged or over-charged, and all operations will obviate the danger of damage to the compressor valves because liquid has been charged (erroneously) into the compressor suction, or discharge service valve ports.</p> <p>Methods for charging must employ the manufacturer's recommendations.</p>	

**C.A.M.A.
ROOM AIR
CONDITIONER**

